

## Stability of climate as viewed from seasonal transitions

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### 1. Introduction

Although the seasonal heating of the earth by the sun is very stable, the seasonal transitions in a specific region on the earth are more variable, since the atmospheric response to the solar heating becomes very complicated under the climatic system on the earth. The seasonal transitions in monsoon region including Japan are pronounced not only in the temperature field but also in the precipitation field. However, it sometimes occurs the abnormal seasonal transition such as end of Baiu season in Japan. For instance, the end of Baiu season was not clear in 1998. In the present study, the authors describe the seasonal transitions of monsoon on a global-scale and long-term variations of seasonal changes in Japan.

### 2. Regional diversity of monsoon climate

Although monsoon climate has a common feature such as rainy season in summer, distinct differences can be found, for example, between the Asian and North American continent. The seasonal wind reversal is pronounced in Asia. Strong convective activity is located over the continent in Asia, while over the ocean in North America. The seasonal transition process is also different between these continents.

### 3. Global view of seasonal transition of monsoon

The convective activity in the tropics is strong over and near the continent and it migrates poleward in summer. Matsumoto and Murakami (2002) partitioned the meteorological variables into equatorial symmetric and asymmetric modes to describe the seasonal transition of monsoon. In the tropical continents such as Africa or America, the convections migrate smoothly from the one hemisphere via equator to the other hemisphere. On the other hand, the seasonal transition over the Asian-Australian region, where typical monsoon climate is recognized, is much more complicated. The northward transition in boreal spring over the western North Pacific is hardly recognized, while the southward transition from the Southeast Asian region to the South Indian Ocean stagnates along the equator. In these periods, small anomalies may influence the seasonal transition process.

### 4. Long-term variations of seasonal divisions in Japan

In order to evaluate the stability of seasonal transitions, the variability of seasonal divisions in Japan was investigated. The climatological season in Japan has been divided into six seasons, with three rainy seasons; winter, Baiu and Shurin (Autumn rain), and three relatively dry seasons; spring, mid-summer and autumn in between. Inoue (2002) objectively defined the natural seasons of Japan in each year for the period 1951-2000. As a result, the onset of winter is most stable; mean date is on November 24 and its standard deviation is 5.0 days. On the other hand, the onset of Baiu is most variable; mean onset is June 10 and its standard deviation is 9.2 days.